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NASA TECH BRIEF

Marshall Space Flight Center

Vapor-Deposited Platinum as a Fuel-Cell Catalyst

In this and several other NASA Tech Briefs (see Note 1), a new fuel-cell system is described. Through the development of an efficient catalyst and the design of several new fuel-cell components and configurations, an important step has been taken toward the day when fuel cells may be used to replace internal combustion engines. This development is particularly important today, because fuel cells are essentially emission-free and, compared to internal combustion engines or generators, obtain considerably more power from the same quantity of fuel.

The first step in the design of a fuel cell is the development of a catalyst that will efficiently push the energy-releasing electrochemical reaction in the cell. This may be done with a new platinum catalyst, with an unusually high activity. It is prepared by vapor deposition on a porous nickel substrate. The nickel plates are prepared by hot sinter pressing of nickel powder, to form a plaque with an average pore size of 1 micrometer and a total porosity of 20 percent.

The electrodes are prepared by vacuum deposition of the platinum on the nickel substrate with a conventional vapor-deposition apparatus. The amount of platinum loaded on the substrate can be varied by changing the exposure time during deposition. The first remarkable result of this process is that the performance of the catalyst is almost independent of the loading (see Figure 1). This is not the case for catalysts prepared by other methods (see Figure 2).

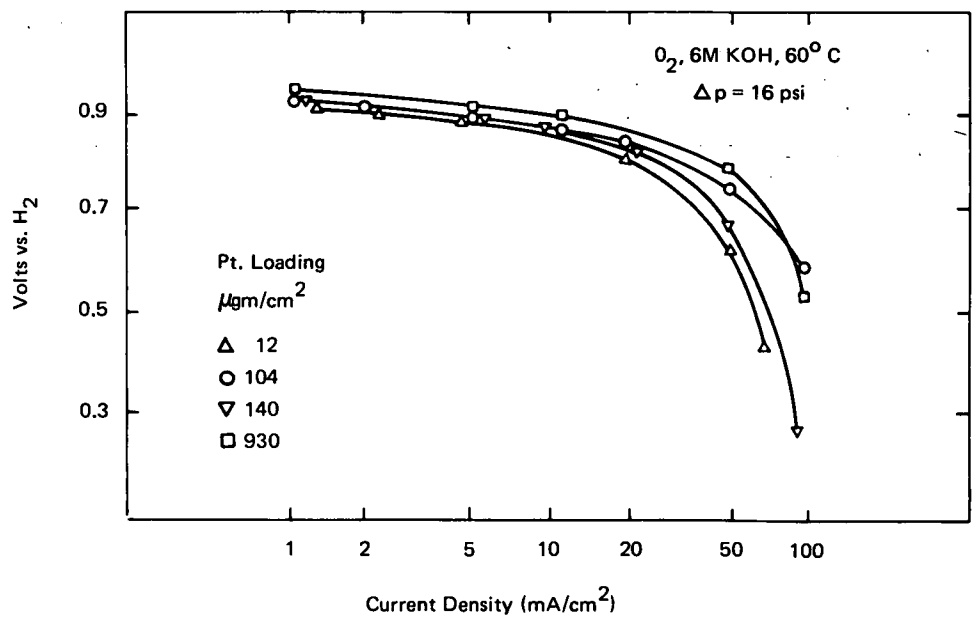

Figure 1. Performance as a Function of Loading: Vapor-Deposited Pt. Electrodes

(continued overleaf)

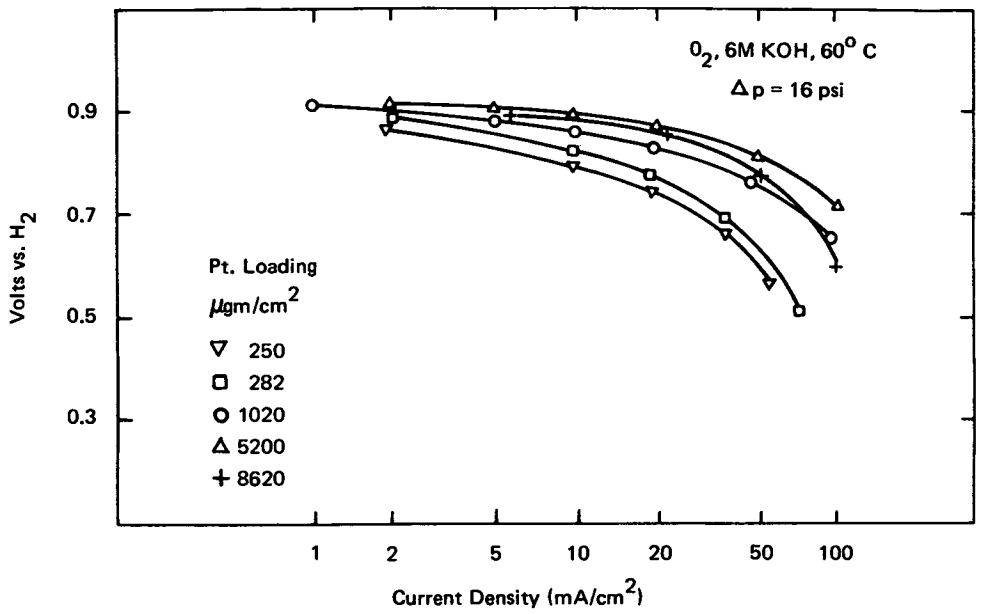

Figure 2. Performance as a Function of Loading: Sputtered Pt. Electrodes

Thus, less of the expensive platinum catalyst may be used, an important economical breakthrough. More important, however, is the discovery that these electrodes, even with the low platinum loading, are significantly more effective than conventional oxygen electrodes. Under identical conditions, the conventional electrode has a specific activity of 5 mA/mg of catalyst; and the vapor-deposited electrode has an activity of 83 mA/mg, a sixteenfold improvement.

Notes:

1. The development of a fuel-cell system is further described in the following NASA Tech Briefs:
   B73-10489, Fuel-Cell Heat and Mass Plate
   B73-10472, A Methanol/Air Fuel-Cell System
   B73-10473, An Electrochemical Engine
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Code A&PS-TU
   Marshall Space Flight Center, Alabama 35812
   Reference: B73-10475

Patent status:

NASA has decided not to apply for a patent.

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J. S. Batzold of
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